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SBIR PHII Contract No. N00014-96-C-2131

High Fidelity Modeling and Imaging for Tactical and Strategic Applications

31 October 1997

MONTHLY R & D PROGRESS REPORT
Covering: 1 October 1997 - 31 October 1997

Contractor's Progress, Status and Management Report (U)
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ACCURATE AUTOMATION CORPORATION

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Attachment: Monthly Progress Report #10

cc: ACO
CO

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Monthly Progress Report #10:
High Fidelity Modeling and Imaging for Tactical and Strategic Applications
Contract N00014-96-C-2131

A. PROGRESS DURING THIS REPORTING PERIOD

AAC has commenced work with funds provided in October on tasks E.1 "Improved SSGM," E.1.1 "Add New Modules," E.1.3 "Expand SSGM Databases," and E.2 "Develop System Architecture." Attachment 1 contains the tasks that support the above paragraphs of the SOW. Funding for this project was received in October 1997. Due to lack of funds from July through September 1997, no work was performed during that period.

It is to be noted that the efforts in tasks 1.4, 1.5, and 1.8 will directly lead to commercializing the SSGM technology. High-accuracy SSGM databases can be used with PC workstations or laptop computers with a modest amount of memory in graphical information services. Civilian applications include:

1. Mapping of the rain forests for early detection of illegally set fires.
2. Two- and three-dimensional images and maps of remote areas for planning of fire fighting and rescue operations.

B. SUMMARY OF PROBLEMS OR CONCERNS

We are expecting additional funds from NRaD to restart the Real Time Retargeting efforts. NRaD has informed AAC that they expect funds early this fiscal year. Funding provided will only partially support the tasks in attachment 1.

C. SUFFICIENCY OF EFFORT TO ACHIEVE OBJECTIVES

See funding discussion in para. B.

D. PLANS FOR THE NEXT REPORTING PERIOD

We plan to continue to develop the system architecture and plan to develop innovations in the neural filter to generate the deltas that will enhance the SSGM model.

E. NOTES

None.

Sincerely,
ACCURATE AUTOMATION CORPORATION

Richard Akita

Richard Akita
Principal Investigator

Task 1: Improve SSGM

During this task Accurate Automation Corporation will develop core technologies required for automated image analysis and model/measurement comparison culminating in a prototype software tool. This tool will provide automated analysis of differences between modeled and measured images, allowing highly accurate scene generation anywhere in world from aerospace sensors. The system developed during this task represents amplifications to the improvements specified in Task E.1 and Task E.2 of the Phase II proposal statement of work.

Task 1.1: Develop Integrated Model/Measurement System Architecture

During this task Accurate Automation Corporation will specify the system architecture for our integrated model/measurement tool. This tool will allow the blending of measured data into the synthetic scene for improved accuracy. The block diagram in Figure 1 describes the process for using our tool. Existing components to be integrated into the software must be identified and their interaction with the tool clearly specified. In particular, existing components of SSGM that will be integrated must be identified as well as any GOTS visualization and analysis tool such as the Navy developed Visual Interface for Space and Terrestrial Analysis (VISTA).

We will also investigate methods for distributing the processing across a network of workstations. A distributed architecture could provide benefits of system load balancing and connectivity to non-local databases. A distributed architecture could allow our tool to be ported to a non-SGI environment such as Windows NT. From a Windows NT workstation a user would have access to the core functionality of the supporting tools such as SSGM. This subtask corresponds to task E.2 of the Phase II proposal statement of work.

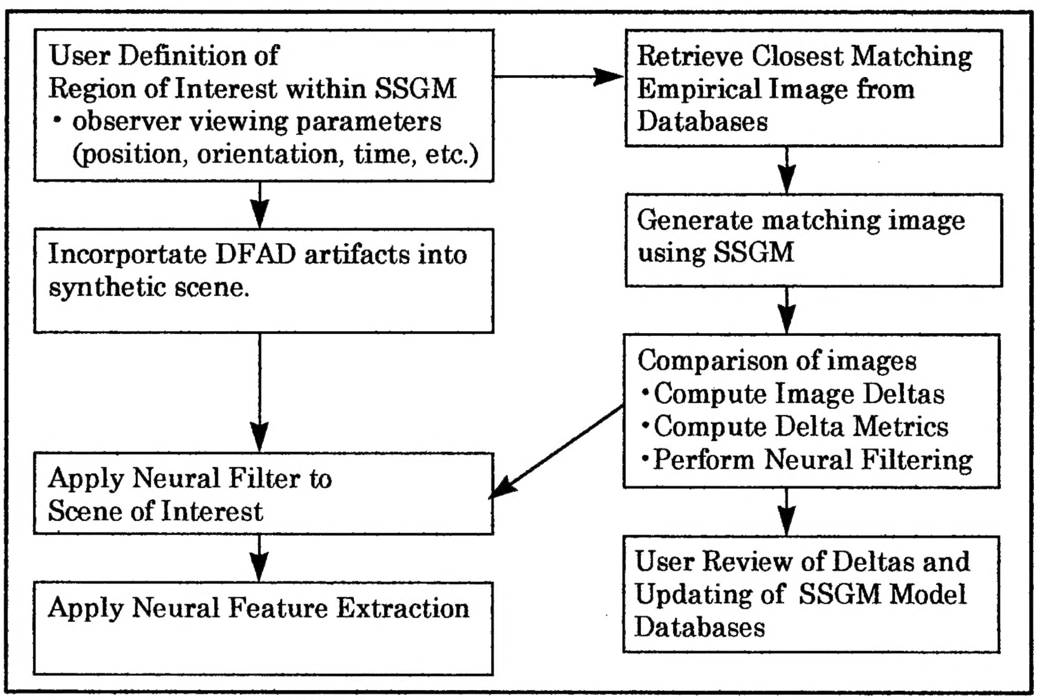

Figure 1: Functional Block Diagram

Task 1.2: Develop Innovative Neural Network Filtering Capability.
During this task Accurate Automation Corporation will research neural network methods for automating synthetic image enhancement . There will always be some difference between the measured image and the synthetic image. We anticipate that this difference will be related to the conditions under which the measurement was made, i.e., the context for the measurement. Using the baseline errors between "control" measured and synthetic images, we believe we can filter some modeling errors from closely related synthetic images. We will develop a neural network architecture that will take into account both overall context parameters, local conditions in the viewing area and parameters by which the image sensing and preprocessing are carried out. This neural network will operate on a "difference image" which is the subtraction of the measured image from the synthetic image. By learning generalizations regarding modeling errors for specific operating contexts, the neural network should be able to filter similar synthetic images to more closely approximate what would be measured. This neural network filtering system will be packaged as a supporting module for SSGM. This subtask corresponds to task E.1.1 of the Phase II proposal statement of work.

Task 1.3: Develop Innovative Neural Network Feature Extraction Capability.
During this task Accurate Automation Corporation will research neural network methods for automating feature extraction for classification. Independent of improvements in the synthetic model, we anticipate regions within a image will have high salience to the operator or autonomous system. For surveillance applications, the presence or absence of features could be of interest to an operator or system. We will devise a neural network method, based on AAC's innovative multilayer cooperative-competitive neural network, to identify and tag or extract these regions of high saliency. The neural network feature extraction system will be packaged as a supporting module for SSGM. This subtask corresponds to task E.1.1 of the Phase II proposal statement of work.

Task 1.4 Develop Distributed Client-Server Architecture
During this task Accurate Automation Corporation will implement the multi-tiered client-server architecture specified in task 1.1. We will investigate open system middle-ware such as the *Common Object Request Broker Architecture* (CORBA) for implementing the distributed system. As opposed to a single monolithic system, a multi-tier approach divides applications into cooperating parts. Using accepted open system middle-ware such as CORBA should simplify implementation and expand the dual-use potential of the complete system. The current capabilities of SSGM, for example, would reside on SGI servers that could be accessed by remote users from Windows NT workstations.

Task 1.5: Design and Develop User-Interfaces
During this task Accurate Automation Corporation will design and build the graphical user-interface to achieve the architectural capabilities specified in Task 1.1 for our system. Hooks into existing user-interfaces for all GOTS software to be integrated must be designed to present a consistent "look-and-feel" to the user. For example, when a user needs to construct a new scenario under SSGM, our tool should provide them access to the SSGM Scenario Construction Tool (SCT). We will design the user-interface to be compatible with the User Interface Specifications for the Defense Information Infrastructure (DII) v2.0. We will investigate using Java as the implementation language for our graphical user-

interface. We intend to leverage the Java's portability capabilities and built-in interfacing libraries to allow multiple platforms to be clients in our distributed system.

Task 1.6: Automated SSGM Scenario File Creation.
During this task we will research methods to automate the process of generating an SSGM scenario file to match an empirical image from an archive. Generating a synthetic match to a measured image will allow us to generate baseline errors between model and measurement. These errors will be used in processing the scene of interest. An SSGM image is completely described by its scenario definition file which is an ASCII text file. We intend to leverage information that will be stored in the imagery database to provide SSGM with the parameters needed for specifying a scenario definition file. The user will be to review the results of the generated scenario definition file and to edit any of the generated parameters. This system will be packaged as a supporting module for SSGM. This subtask corresponds to task E.1.1 of the Phase II proposal statement of work.

Task 1.7: Radiance Modeling of DFAD Artifacts.
While SSGM has very good software components for modeling atmospheric and celestial effects, it lacks some capabilities which are necessary for our applications. One of the shortcomings of SSGM is the capability to include radiance models of objects other than missile hardbodies. During this task Accurate Automation Corporation will investigate developing a radiance model database of DFAD artifacts for incorporation into the synthetic images. Hooks will be established with SSGM to accept the radiance models and to use them in the generation of images.

A set of tactical models will be defined for addition to the SSGM database. We plan to examine the Naval Warfare Tactical Database (NWTDB), identify, and include models that are appropriate. A wide range of models will be important for mission planning and rehearsal applications as well as surveillance applications, including vehicles, buildings, bunkers, roads, and airports. This subtask corresponds to task E.1.3 of the Phase II proposal statement of work.

Task 1.8: Demonstrate Prototype System
A demonstration of the prototype system developed by Accurate Automation Corporation will be scheduled. AAC will demonstrate our system's ability to enhance synthetic images using our neural filter from a client Windows NT station connected to our distributed architecture. We will also demonstrate the neural feature extraction capability for the specific application chosen as part of task 1.3.